A STUDY OF *GORTYNA BORELII LUNATA* FREYER (LEP.: NOCTUIDAE): RESULTS FROM THE FIRST SEASON OF BEHAVIOURAL OBSERVATION SESSIONS

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Introduction

FISHER'S ESTUARINE MOTH *Gortyna borelii* Pierret, 1837 ssp. *lunata* Freyer 1839 is a large noctuid moth, which has only ever been recorded in Britain from the North Essex coast, within the Walton Backwaters area (Skinner, 1998; Thompson and McClean, 1999; Hart, 1999). Subspecies *lunata* is darker in colour and larger in size than the nominate subspecies (Ippolito and Parenzan, 1978).

The genus *Gortyna* Ochsenheimer is closely related to *Hydraecia* Guenée (Heath and Emmet, 1983). *G. borelii* was initially identified as *Hydraecia leucographa* Borkhausen 1792, however, the name has since been found to be invalid due to an interpretation mistake (Ippolito and Parenzan, 1978).

G. borelii has a widespread, but very localised, European distribution, and is found at altitudes of up 1000m (Gyulai, 1987). It has been recorded from a number of locations in Southern and Central Europe, including central and southern France, Poland, Hungary, Germany and Portugal (Ippolito and Parenzan, 1978), whilst Karsholt & Razowski (1996) also list Italy, Hugary, Yugoslavia, Romania and Bulgaria. Populations in Central Europe are the subspecies *lunata* (Gyulai, 1987).

In Britain, *G. borelii lunata* is included in the *British Red Data Book* (Shirt, 1987) and protected under Schedule 5 of the Wildlife and Countryside Act 1981 (*vide* Thompson and McClean, 1999; Gibson, 2000). The moth's larval foodplant, Hog's Fennel *Peucedanum officinale*, is also listed in a UK Red Data Book. *Peucedanum officinale* is a rare and local species with a British distribution limited to only two main areas: the North Essex and northern Kent coasts (Randall and Thornton, 1996).

Gortyna borelii lunata was first discovered in Britain in 1968 when Mr J. B. Fisher took a specimen at a lighted window and, subsequently, two more specimens at a mercury-vapour light trap (Fisher, 1971). It has since been reported that, although this species can be found at mercury-vapour light, it has a particularly strong attraction for actinic light (Heath and Emmet, 1983). However, there have also been reports that this species is not drawn to light (Kovács, 1955).

Although there has been much interest in *G. borelii lunata* in Britain since it was discovered in 1968, there is still much to learn about the moth's basic biology. For example, where exactly does the *G. borelii lunata* lay its eggs in the wild? Why are there such high mortality rates between the small and large larval stages? Does the adult moth actually feed? And, what are the behavioural characteristics of the larval stages and the adult moth?

If answers are found to questions such as these then we will be in a much better position to secure the future of *G. borelii lunata* in Britain. The moth and its foodplant are both under threat from sea level rise, because the majority of the Essex

population of *P. officinale* grows below the two-metre contour line. Indeed, to secure the long term future of *G. borelii lunata* in Britain, the moth and its host plant will need to be established at sites further inland. To successfully establish new colonies we need to acquire a lot more information on the habitat requirements of both *G. borelii lunata* and *P. officinale*.

In September 1999, a three-year PhD study of *G. borelii* was commenced at Writtle College, Chelmsford, Essex. The study is partially funded by English Nature as part of their Species Recovery Programme, the Essex and Cambridgeshire Branch of Butterfly Conservation and the Environment Agency. The main aims of the project are to carry out a life history study on *G. borelii lunata* and to determine the moth's habitat requirements. The results obtained should enable recommendations for habitat management to be made for the existing colonies, and will enable us to be in a better position to establish new colonies successfully.

As the study was commenced in September 1999, it has as yet only been possible to observe the flight period of the adult moth. This paper presents the results from behavioural observations carried out in September and October 1999.

Methodology

G. borelii lunata was observed in the wild at a site within the Walton Backwaters area. Behavioural observations were carried out by observing the moth using torchlight (the behaviour of this species does not appear to be affected by torchlight). On sighting and identifying *G. borelii lunata*, the sex was established and it was then observed for a period of approximately two hours, or as long as it was possible to keep sight of the specimen.

A total of eight behavioural observation sessions were carried out during the flight period (mid-September to mid-October). Males were observed on three of these sessions and females on five. Each of the observation sessions was carried out at a different time between dusk and dawn, and over the course of the eight sessions, every hour between 19.00 hours and 07.00 hours had been covered.

At the beginning and end of each behavioural observation session, details of the weather conditions (temperature, wind direction and speed, and cloud cover), were recorded to enable an assessment of the impact of differing conditions on the behaviour of the moth to be made. The behavioural observation sessions involved recording the behaviour of the moth at one minute intervals, noting any changes in behaviour between these intervals.

The behavioural acts observed were categorised into the following specified groups: resting, wing movement, grooming, crawling, flying, and oviposition (see Table 1 for details). The duration of each behavioural category interval was calculated as a proportion of the observation period, and the results from observation sessions were presented graphically.

Results

The results illustrate that the male and female adult moth both have quite different behavioural characteristics. The behaviour of males tends to consist of resting until

approximately 23.00 – 24.00 hours BST, followed by wing movement and grooming before taking flight and being lost from sight (Fig. 1). A male was observed crawling on only one occasion.

Categorised behavioural act	Behaviour observed
Resting	Stationary: wings closed
Wing movement	Stationary; wings open (either still or flapping)
Grooming	Stationary; moving legs or antennae, or defecating
Crawling	Crawling only (wings may be still or flapping); not probing with ovipositor
Flying	Flight; completely airborne
Oviposition	Probing with ovipositor; eggs may or may not be being laid

Table 1. Explanation of categorised behavioural acts.

The behaviour of females was considerably more varied than that of the males and they also tended to be active much earlier in the night, from as early as 20.00 hours. Females were then active for intermittent periods of varying lengths right through the night until about 05.00 hours. After this time they crawled down amongst the vegetation and rested close to ground level. During the course of the night, females tended to be quite erratic in their behaviour, which was characterised by resting, crawling and oviposition bouts (Fig. 2).

When active, the behaviour of females consisted predominantly of crawling up and down vegetation, particularly grass, sometimes probing the grass with their ovipositor and frequently falling from the grass to the ground, making no attempt to fly. However, they were observed flying on two occasions, both of which were quite poor attempts, when they flapped around erratically and covered a distance of just one metre or so. Crawling behaviour was generally observed preceding and subsequent to oviposition bouts (Fig. 2).

Egg-laying was observed on five occasions, and on each occasion the eggs were deposited on Sea Couch Grass *Elytrigia atherica*. Females laid their eggs by probing between the grass stem and the outer leaf sheath of the grass (Plate A), and laying the eggs in a line tucked beneath the outer leaf sheath (Plate B). The eggs were laid at heights of between seven and fifty-five centimetres from ground level. The duration of egg-laying bouts varied from just five minutes to forty-eight minutes in length. The number of eggs laid per bout varied quite considerably; on one occasion at least one hundred eggs were laid.

The impact of weather conditions on the behavioural activity of the moth is difficult to assess, due to the small number of observation sessions carried out. *Gortyna borelii lunata* was, however, more active on nights when the temperature was above 10°C. Indeed, the moth remained almost completely stationary during observation sessions when the temperature was below 8°C.

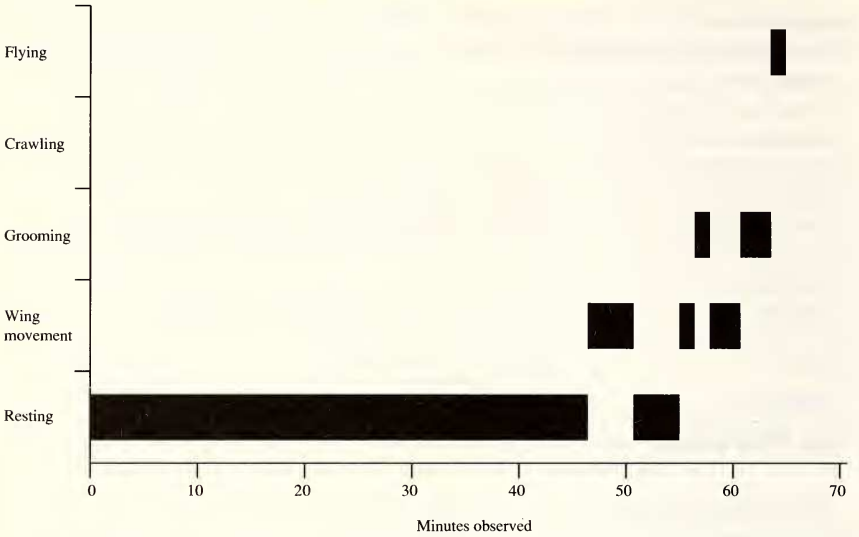

Figure 1. Male behavioural observation session. Observations were carried out on 29 September 1999 between 22.52 hours and 23.59 hours.

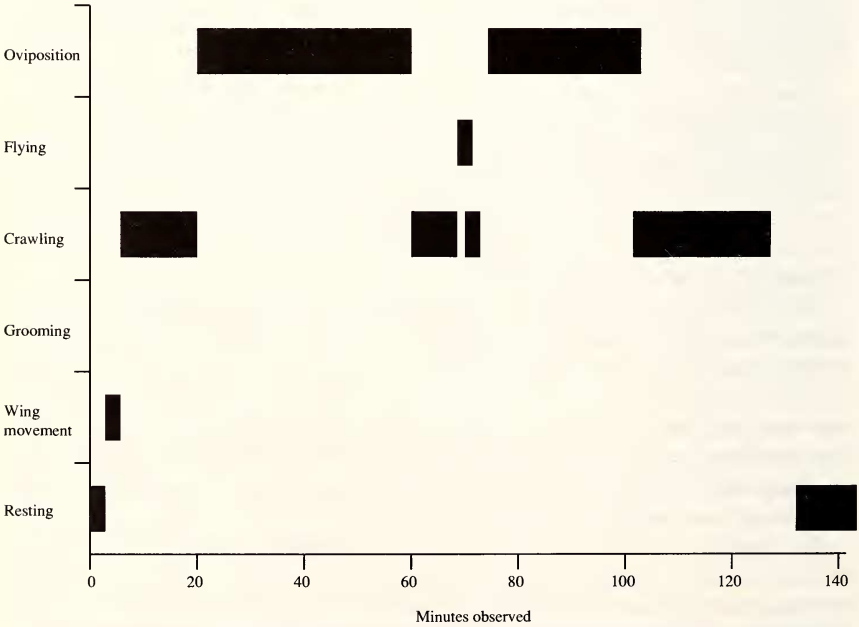

Figure 2. Female behavioural observation session. Observations were carried out on 8 October 1999 between 19.40 hours and 22.03 hours.

Discussion

The behavioural observation sessions have provided some important information on a species that is very poorly understood. Knowledge of the behavioural characteristics of *G. borelii lunata* will provide information that is necessary in determining the habitat requirements of this species. Although the behavioural observation sessions have as yet involved observing only one of the life cycle stages for a relatively short period of time, some important preliminary observations have been made, the most notable of which are the differences between male and female behaviour and the oviposition observations.

The oviposition observations that were made have already provided information that is important to the conservation management of the moth. Many of the sites that support *G. borelii lunata* are currently being managed under mowing regimes and current recommendations are that if the sites must be mown, this should be carried out when the moth is feeding and pupating underground in the August to September period (Hart, 1999; C. Gibson pers. comm.). However, the fact that *G. borelii lunata* has been observed ovipositing on a long grass species, *Elytrigia atherica*, may alter this recommendation, since mowing in August may prevent the grass from growing to a sufficient height for oviposition by the moth in mid September to October. An experiment to determine the impact of different mowing regimes on the abundance of the moth at specific sites will be carried out as part of this PhD study.

Hart (1999) observed that the most favoured sites for *G. borelii lunata* larvae were where *P. officinale* grows amongst long rank grass. In this study it has also been observed that the adult moth is more abundant in areas where *P. officinale* is growing amongst long grass. Consequently, factors such as grazing may have a negative impact on the abundance of this species. The impacts of grazing on populations of *G. borelii lunata* will also be investigated over the three-year duration of this study in a series of exclusion experiments.

Previous observations of *G. borelii lunata* oviposition have suggested that the moth lays its eggs within the leaf axils of the host plant, *Peucedanum officinale* (J. Firmin pers comm.). There have also been observations of the moth laying its eggs on dead grass stems, between the stem and the outer sheathing (Platts, 1981; D. Down pers comm.). It may be that the moth lays its eggs on both the host plant and the surrounding grass species. Consequently, further investigation into the egg laying preferences of this species at different sites is required.

As mentioned above, the genus *Gortyna* is closely related to the genus *Hydraecia*. The species *Hydraecia immanis* and *Hydraecia micacea* are both known to lay their eggs between the stem and leaf sheath of various grass species, particularly *Elytrigia repens* (French *et al*, 1973; Deedat *et al*, 1983; Giebink *et al*, 1984; Levine, 1986). This oviposition behaviour is very similar to that observed for *G. borelii lunata* during the behavioural observation sessions.

Over the next three years, the behavioural observation sessions will be continued on a number of different sites, and further details of the behavioural characteristics of the moth will be acquired. There are still many questions to be answered, such as

where and how far do males fly? What is the mating behaviour of this species? And, more observations on oviposition behaviour are still required. The other life cycle stages will also be observed in the forthcoming season.

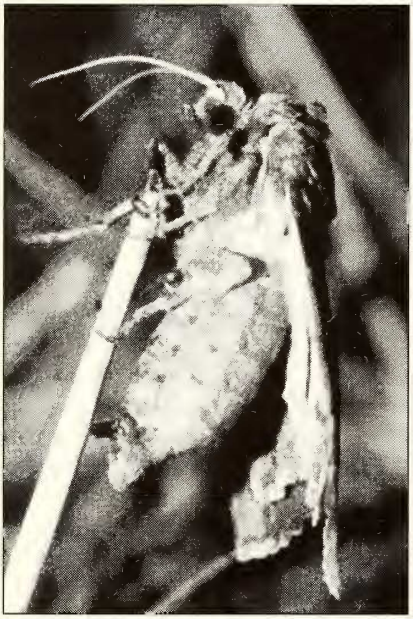

Plate A: *Gortyna borelii lunata* ovipositing on *Elytrigia atherica*

Photo credit: Micky Andrews

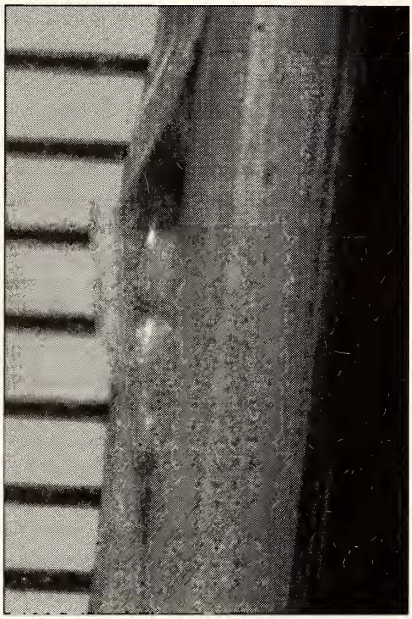

Plate B: *Gortyna borelii lunata* eggs laid on *Elytrigia atherica*. The horizontal lines on the left of the picture are at 1 millimetre intervals.

Photo credit: Micky Andrews

Advice requested concerning the breeding of captive stock

Part of the PhD study involves the establishment of a captive stock. This is to enable detailed life cycle observations to be carried out, and possibly to determine whether successive captive generations produce genetic differences in fertility, fecundity etc.

If you have had experience in rearing captive *Gortyna borelii* stock ZR would be very grateful if you could offer her some practical information and advice. It is important to note that the species has been protected since 1998 under Schedule 5 of the Wildlife and Countryside Act 1981, making it illegal, amongst other things to catch, kill or injure the moth in any of its stages, or to keep and rear specimens of wild origin, without a licence from English Nature. Any animal thus protected is deemed to be wild unless the contrary can be demonstrated. Captive-bred (not captive-reared) stock is not wild in this context. Thus, if anyone holds captive-bred stock, ZR would be pleased to hear from them. Experiences and observations will be of great value to further studies and, importantly, by registering details of the area of origin and dates of capture of the founder stock, the legality of your holding can be established as documentary evidence.

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